PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
H04N 1/60, G02F 1/1335

A1

(11) International Publication Number: **WO 97/35424**

(43) International Publication Date: 25 September 1997 (25.09.97)

(21) International Application Number: PCT/US97/04501

(22) International Filing Date: 20 March 1997 (20.03.97)

(30) Priority Data:
08/621,289 22 March 1996 (22.03.96) US

(60) Parent Application or Grant
(63) Related by Continuation
US 08/621,289 (CIP)
Filed on 22 March 1996 (22.03.96)

(71) Applicants *(for all designated States except US)*: R.R. DONNELLEY & SONS COMPANY [US/US]; 77 West Wacker Drive, Chicago, IL 60601-1696 (US). GRAPHIC ARTS TECHNICAL FOUNDATION [US/US]; 4615 Forbes Avenue, Pittsburgh, PA 15213-3796 (US).

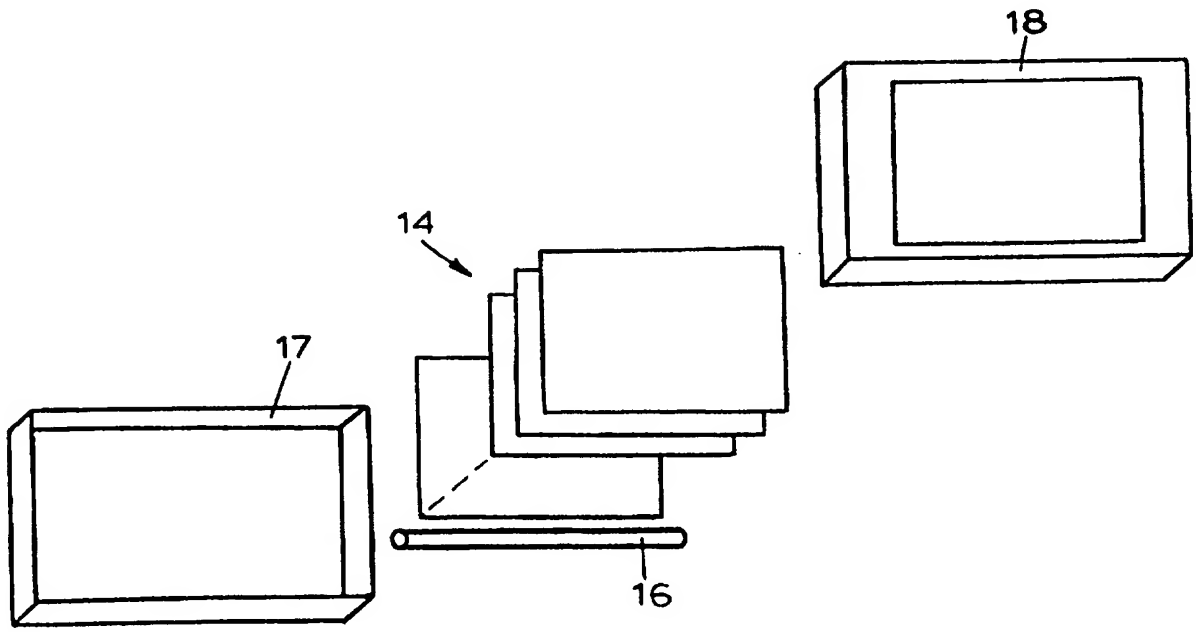
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: LIND, John, Thomas [US/US]; 6720 Old Mars Criders Road, Cranberry Township, PA 16066 (US). REEVES, Donald, N. [US/US]; Apartment 15B, 1501 State Parkway, Chicago, IL 60610 (US). WARNER, Richard, David [US/US]; 114 Rogers Drive, Clinton, PA 15026-1324 (US).

(74) Agent: McCRACKEN, William, E.; Marshall, O'Toole, Gerstein, Murray & Borun, 233 South Wacker Drive, 6300 Sears Tower, Chicago, IL 60606 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SOFT PROOFING DISPLAY



(57) Abstract

A display for soft proofing an image to be reproduced using a set of selected printing colors includes a plurality of display elements each for displaying a color substantially spectrally matched to one of a set of printing colors.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania
AM	Armenia
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GH	Ghana
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakstan
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
MK	The former Yugoslav Republic of Macedonia
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
YU	Yugoslavia
ZW	Zimbabwe

SOFT PROOFING DISPLAY

Technical Field

The present invention relates generally to printing production processes prior to printing, and more particularly to an apparatus and method for creating soft proofing color filters.

Background Art

Printing processes typically involve the creation of one or more proofs that allow the printer or printing customer to view a sample of the image to determine if words are spelled correctly, if images are located as desired and to determine if colors have been reproduced satisfactorily. There are multiple points in the printing process where an image or composite of images may be critiqued. Proofing is a time-and-material consuming step in the printing process, but is traditionally considered to be necessary so that alterations and/or corrections, often at the last minute, can be made.

At first, proofs were made on the press used to print the job. Specifically, plates were made from composed films and one or more proofs were printed using the plate, ink and paper of the job. Often, several copies were printed for the approval of the customer. This proofing method is still the method of choice when large numbers of samples (referred to as "press proofs") are required. Such proofs are as close as possible to the output to be produced by the job.

Because of the length of the traditional proofing cycle, products were developed that could lead to substantial reduction in proofing time. Such proofing processes create "offpress" proofs by sequentially exposing

the four color films onto photosensitive colored composite layers that simulate the printed sheet. The colorants in the photosensitive foils are pigments that are similar to the printing ink pigments. The four colored foils are laminated, and exposed through films, in register on a white receiver sheet to produce the final offpress proof. Typically, these proofs were made immediately after the color scanning process, after color scan corrections were made and then again for the final composite proof. Of course, every adjustment required another proof to show the effect of the changes. Typical examples of offpress proofs are Cromalin by DuPont and Matchprint and Transfer Key by Imation.

If only one or two copies of a proof are required, the offpress proof is less expensive than a press proof. While the spectral match to ink and paper may not be totally perfect, it is close enough to be a useful guide to color approval. The time required to prepare offpress proofs that are of contract quality and acceptance is approximately 25 to 45 minutes per proof, as compared to the two to four hour time required for press proofing. Until recently, this turnaround time was generally considered acceptable.

In the 1980's, desktop publishing became a reality. Computers were finally powerful and inexpensive enough to allow for prepress color preparation off-site (e.g., at the publisher) from the color trade shop and printing plant. The results of color scans were displayed on cathode ray tube (CRT) color monitors. Color corrections and image manipulation were performed on the color monitor in the red-green-blue phosphor color space and transformed into cyan-magenta-yellow-black (CMYK) printing plate files. The CMYK files were converted to

films and offpress proofs or press proofs were made from the films. From the beginning, there was a desire to use the color monitor as a soft proofing medium, but there were some limitations. The customer would need a remote color monitor for simultaneous viewing of the proof. Further, the viewing conditions would have to be controlled and/or standardized. Also, the color reproduced by the monitor was not considered to be representative of ink on paper, and therefore not useful as a consistent guide to color proofing owing to manufacturing processes, inherent differences between reflective and self-luminous displays and the spectral mismatch between monitor primary colors and ink colors.

The demand for a soft proofing device has continued to increase, accelerated by other technological developments, primarily the "computer-to-plate" and "computer-to-press" printing processes. This technology has the potential to eliminate film completely, thus eliminating the offpress proof and increasing the demand for a high fidelity soft proofing system. Also, image assembly and page imposition in these processes are accomplished by manipulating data files, resulting in a significant reduction in the amount of time required to undertake these tasks and thereby shifting the production bottleneck to the proofing process.

Schreiber, U.S. Patent No. 4,500,919 discloses a system for reproducing colors including apparatus for causing a reproduction on a CRT to be a colorimetric match for a final printed page. Changes to the image can be interactively made by observing the image on the CRT as adjustments are made.

Summary of the Invention

A display for soft proofing permits a user to inspect a proof of a printed page in a simple and inexpensive manner.

More particularly, according to one aspect of the present invention, a display for soft proofing an image to be reproduced using a set of selected colorants includes a plurality of display layers each comprising a light-sensitive coating of pigmented material which is exposed through a mask and developed and means for illuminating the plurality of display layers. The display appearance is substantially spectrally matched to the set of colorants.

According to a further aspect of the present invention, a method of forming a display panel for soft proofing an image to be reproduced using a set of selected printing colorants includes the steps of providing a substrate, forming a first display layer on the substrate, forming a second display layer on the first display layer and forming a third display layer on the second display layer. Each of the forming steps comprises the steps of depositing a layer of liquid pigmented materials, exposing the layer of pigmented materials through a mask and developing the exposed layer of pigmented materials. The display appearance is substantially spectrally matched to the set of printing colorants.

The apparatus and method of the present invention are capable of providing a better match to a printed reproduction than prior systems and methods.

Other features and advantages are inherent in the apparatus claimed and disclosed or will become apparent to those skilled in the art from the following detailed description in conjunction with the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a block diagram of a computer-to-plate or computer-to-press system including a display according to the present invention;

Fig. 2 comprises an exploded diagrammatic view of the display of Fig. 1;

Fig. 3 comprises a cross-sectional view of an assembled filter used in the display of Fig. 2; and

Fig. 4 illustrates an assembled display consisting of the color filter of Fig. 3, using the colorants of the present invention, shown by way of example with an electronically addressable white light modulating unit of the liquid crystal type.

Description of the Preferred Embodiments

Referring now to Fig. 1, a computer-to-plate or computer-to-press system 10 includes a scanner 11 or other digitizing apparatus for scanning an original 12 to develop digital data representing a characteristic (such as reflected light intensity) of each of a plurality of picture elements (or pixels). In the preferred embodiment, the original 12 comprises a color image and the scanner 11 develops data for each pixel for the red, green, or blue component of the image characteristic at such pixel. The scanner output data are provided to a computer 13 which converts the data into suitable data for operating one or more plate making devices to prepare plates for printing. Alternatively, the computer 13 may develop appropriate data for one or more electronic presses, if desired.

The computer 13 may further develop data for operating a display 14 for viewing the scanned image. If desired, the display 14 comprises a liquid crystal display (LCD) according to the present invention.

The scanned data from the scanner 11 is transformed into appropriate values to operate the display 14, as should be evident to one of ordinary skill in the art. The computer 13 may further provide such data to a different computer, for example, over a communications link, which in turn may operate a remote LCD display according to the present invention to allow soft proofing at such remote location.

Fig. 2 illustrates one example of the display 14 of Fig. 1 in greater detail. The display 14 includes a plurality of colored display elements or layers, together with an electronically controllable means 16 of illuminating the colored display elements, enclosed by an enclosure including a back cover 17 and a front cover 18.

Referring now to Fig. 3, the display layers include a glass substrate 21 with a filter stack 22, consisting of a plurality of pigmented layers of material, each of which may comprise a pigmented acrylic, pigmented photoresist or other pigmented composite. A planarizing layer 24 is located on top of the stack and display addressing electrodes 25 are located on the planarizing layer 24. The filter stack, together with the planarizing layer and display electrodes may be manufactured in accordance with the teachings of the U.S. Patent No. 5,463,484, the disclosure of which is hereby incorporated by reference herein.

In accordance with the present invention, the selection of the particular colors for the pigmented acrylic or pigmented photoresist layer 34 can be made keeping in mind the particular inks and paper to be used in the final printing process, as well as the type of printing process (e.g., gravure, offset, flexography, etc...). Generally, if a set of selected printing inks or colors are

to be used to reproduce an image, a plurality of display elements in the form of the pigmented layers 23 are selected each for displaying a color substantially spectrally matched to one of the set of printing colors. It is preferable that the spectral curve of each light source 16 be as flat as possible over the visible spectrum. In addition, the intensity or brightness of the illumination means 16 may be limited to limit the color gamut produced by the display, if desired. Gamut flexibility may also be affected by the choice of the spectra of the pigmented layers 23 and the color temperature of the light source(s).

If desired, the pigmented layers 23 may have spectral characteristics matched to non-process colors, such as red, green, and blue, or any other color, such as a color used in a particular trademark or other image. If desired, one could select a filter with cyan, magenta and yellow pixel elements and produce a resultant secondary color.

Still further, a greater or lesser number of pigmented layers 23 may be used. For example, the process colors may be used in combination with one or more non-process colors, as desired.

Still another alternative is to select pigmented layers 23 and/or select the color temperature of the illumination source 16 and/or control the brightness thereof to permit reproduction of colors beyond the color gamut that can be reproduced using ink and paper.

By appropriate selection of the pigmented layers, a broad spectral curve can be obtained for each primary color of the display. Such curves more closely approximate the spectral characteristics of ink on paper than the phosphors of a CRT, which are relatively narrow-band and

cannot produce the color fidelity necessary to match inks on paper.

The method of the present invention is not restricted to specific colors, and any combination and number of colors and layers can be utilized to generate color filters both of the additive color and subtractive color variety.

Fig. 4 shows a completed display including the color filter and a means for electronically modulating the brightness of an incident white light source, here chosen to be a nematic liquid crystal layer for purposes of illustration. Adhesive or other means is provided to hold the various layers together.

A nematic liquid crystal layer 26 is located between alignment layers 29 and addressing electrodes 25 and 27 on opposite sides. The color filter stack 22 and planarizing layer 24 are constructed in accordance with U.S. Patent No. 5,463,484, wherein the colorants can be those described above in accordance with the present invention. Two glass panels 21 and 28 enclose the assembly described and linear polarizing filters 30, arranged in mutually perpendicular orientations are attached to the two outside faces of the assembly.

A planar white light source 31, which may comprise the illuminating means 16 and which uniformly illuminates the entire display area, completes the display system. It will be understood that Fig. 4 illustrates one possible passive or active matrix display assembly according to the present invention and that other means of illuminating the colored elements with electronically modulated white light are equally within the purview of the present invention. For example, a cathode ray tube (CRT), preferably of the black and white type, may be provided

behind the color filter stack 22 and the brightness of various regions of the CRT may be controlled to reproduce the image. Alternatively, a particle layer or film layer may be suspended behind the color filter stack 22 and may be backlit. The particle or film layer may include regions of differing light transparency to reproduce the image. Any other means of producing white light intensities with a substantially flat spectral characteristic curve and having regions ranging from dark to bright in regions corresponding to and aligned with the colored display elements may alternatively be used. The intensity levels of the white light source may further be selected to limit the gamut of displayed colors.

Still further, other fabrication techniques and/or display structures could be used. For example, a glass substrate could be coated with a first layer of pigmented material, such as liquid photoresist in which pigments are dispersed or a pigmented acrylic photopolymer using a particular coating technique (such as a spin coating or spray coating process) and the layer could be exposed through a mask and developed. Two (or more) additional layers of pigmented material could be sequentially deposited over the first layer and similarly exposed and developed. The colors so deposited may be red, green and blue or cyan, magenta and yellow or any other colors. Provided that a reasonable spectral match to ink on paper (or ink or other colorant on another medium) could be obtained, whether by the combination of individual red, green and blue layers or by individual overlapped cyan, magenta and yellow layers, the resulting display panel may then be illuminated and used to perform color proofing. While current spin coating techniques may not be able to produce the required color consistency within the viewing

area or to produce color uniformity from screen-to-screen in a mass production environment, the spin coating technique is sufficiently developed to permit manufacture of limited quantities of displays of acceptable quality. Further, the spin coating technique may be improved and/or another suitable technique may be developed and/or may currently be available to satisfy consistency and uniformity requirements.

It will be apparent to those of ordinary skill in the art that various modifications may be made to the present invention without departing from the spirit and scope thereof. The scope of the present invention is only intended to be limited by the appended claims.

CLAIMS

1. A display for soft proofing an image to be reproduced using a set of selected colorants, comprising:

a plurality of display elements each for displaying a color substantially spectrally matched to one of the set of colorants; and

means for illuminating the display elements.

2. The display of claim 1, wherein the display elements comprise overlapping color filter layers.

3. The display of claim 2, further including securing means including adhesive for maintaining the display elements in overlapping relation.

4. The display of claim 1, wherein the selected colorants comprise printing process colors.

5. The display of claim 1, wherein at least one of the selected colorants comprises a printing non-process color.

6. The display of claim 1, wherein the illuminating means comprises illumination source for backlighting the display elements.

7. The display of claim 6, wherein the illumination source has a substantially flat spectral characteristic curve.

8. The display of claim 6, wherein an intensity level of the illumination source is selected to limit a gamut of displayed colors.

9. The display of claim 1, wherein the illuminating means comprises a cathode ray tube.

10. The display of claim 1, further including means for modulating light produced by the illuminating means.

11. The display of claim 10, wherein the modulating means comprises a plurality of liquid crystal display elements.

12. The display of claim 10, wherein the modulating means comprises a film layer.

13. The display of claim 10, wherein the modulating means comprises a particle layer.

14. A liquid crystal display for soft proofing an image to be reproduced using a set of selected printing colors, comprising:

a plurality of overlapping display elements each for displaying a color substantially spectrally matched to one of the set of printing colors;

means for securing the display elements together to form the display; and

means for backlighting the liquid crystal display layers.

15. The display of claim 14, wherein an intensity level of the backlighting means is selected to limit a gamut of displayed colors.

16. The display of claim 15, wherein the backlighting means has a substantially flat spectral characteristic curve.

17. The display of claim 16, wherein the set of selected colors are process colors including cyan, magenta and yellow.

18. The display of claim 16, wherein the set of selected colors includes at least one non-process color.

19. A method of fabricating a display for soft proofing an image to be printed with selected colors, the method comprising the steps of:

choosing color display elements that are substantially spectrally matched to the selected colors; and

providing means for illuminating the color display elements.

20. The method of claim 19, wherein the illuminating means comprises a black and white cathode ray tube.

21. The method of claim 19, including the further step of modulating light from the illuminating means.

22. The method of claim 21, wherein the modulating step includes the step of operating a set of liquid crystal display elements.

23. The method of claim 21, wherein the modulating step includes the step of providing a film layer.

24. The method of claim 21, wherein the modulating step includes the step of providing a particle layer.

25. The method of claim 19, wherein the illuminating means comprises a source for backlighting the display elements.

26. The method of claim 19, wherein the illuminating means has a substantially flat spectral characteristic curve.

27. The method of claim 19, wherein an intensity level of the illuminating means is selected to limit a gamut of displayed colors.

28. The method of claim 19, wherein the selected colors comprise process colors.

29. The method of claim 19, wherein at least one of the selected colors comprises a non-process color and remaining selected colors are process colors.

30. A method of soft proofing an image to be reproduced using a set of selected colors on paper, the method comprising the steps of:

providing a display having color display elements substantially spectrally matched to the set of selected colors; and

operating the display to reproduce the image.

31. The method of claim 30, wherein the set of selected colors includes three process colors.

32. The method of claim 30, wherein at least one of the set of selected colors comprises a non-process color.

33. The method of claim 30, wherein the step of operating includes the step of backlighting the display with an illumination source.

34. The method of claim 33, wherein the illumination source has a substantially flat spectral characteristic curve.

35. The method of claim 34, wherein an intensity level of the illumination source is selected to limit a gamut of displayed colors.

36. A display for soft proofing an image to be reproduced using a set of selected colorants, comprising:

a plurality of display layers each comprising a coating of pigmented material which is exposed through a mask and developed; and

means for illuminating the plurality of display layers wherein the display appearance is substantially spectrally matched to the set of colorants.

37. The display of claim 36, wherein each coating of pigmented material is deposited on a glass substrate by a coating process.

38. The display of claim 37, wherein the pigmented material comprises a photoresist in which a pigment is dispersed.

39. The display of claim 37, wherein the pigmented material comprises a pigmented acrylic photopolymer.

40. The display of claim 37, wherein the coating process comprises a spin coating process.

41. The display of claim 37, wherein the coating process comprises a spray coating process.

42. The display of claim 36, wherein the display layers comprise red, green and blue display layers.

43. A method of forming a display panel for soft proofing an image to be reproduced using a set of selected printing colorants, the method comprising the steps of:

providing a substrate;

forming a first display layer on the substrate;

forming a second display layer on the first display layer; and

forming a third display layer on the second display layer, wherein each of the forming steps comprises the steps of depositing a layer of light-sensitive liquid pigmented material, exposing the layer of pigmented material through a mask and developing the exposed layer of pigmented material and wherein the display appearance is substantially spectrally matched to the set of selected printing colorants.

44. The method of claim 43, wherein the step of depositing in each of the forming steps comprises the step of spin coating the layer of liquid pigmented material.

45. The method of claim 43, wherein the step of depositing in each of the forming steps comprises the step of spray coating the layer of liquid pigmented material.

46. The method of claim 43, wherein the pigmented material comprises a photoresist in which a pigment is dispersed.

47. The method of claim 43, wherein the pigmented material comprises a pigmented acrylic photopolymer.

48. The method of claim 43, wherein the display layers comprise red, green and blue display layers.

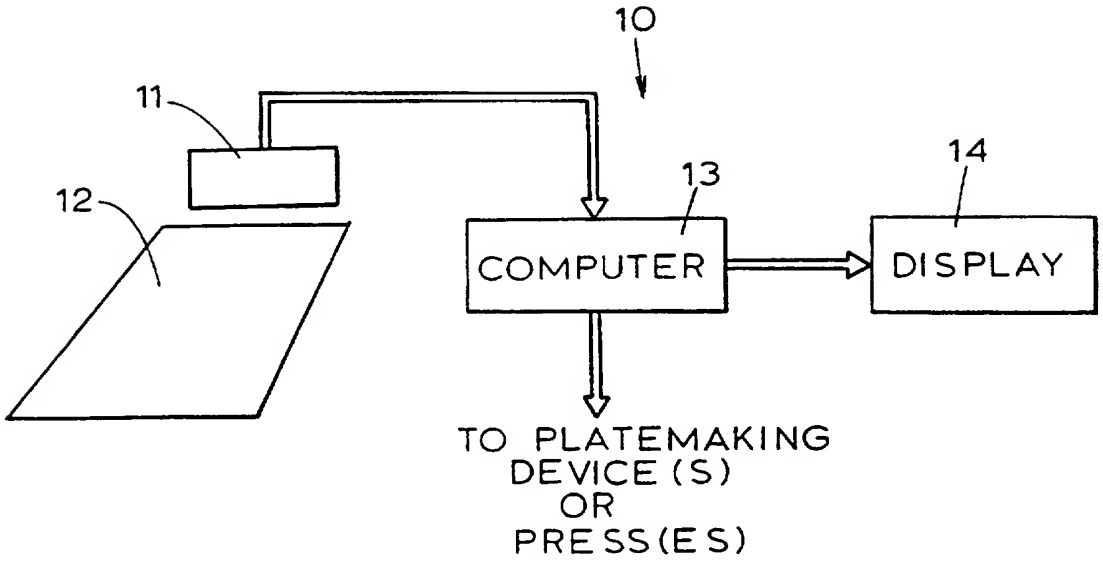

10
11
12
13
14
COMPUTER
DISPLAY
TO PLATEMAKING
DEVICE(S)
OR
PRESS(ES)

FIG. 1

FIG. 2

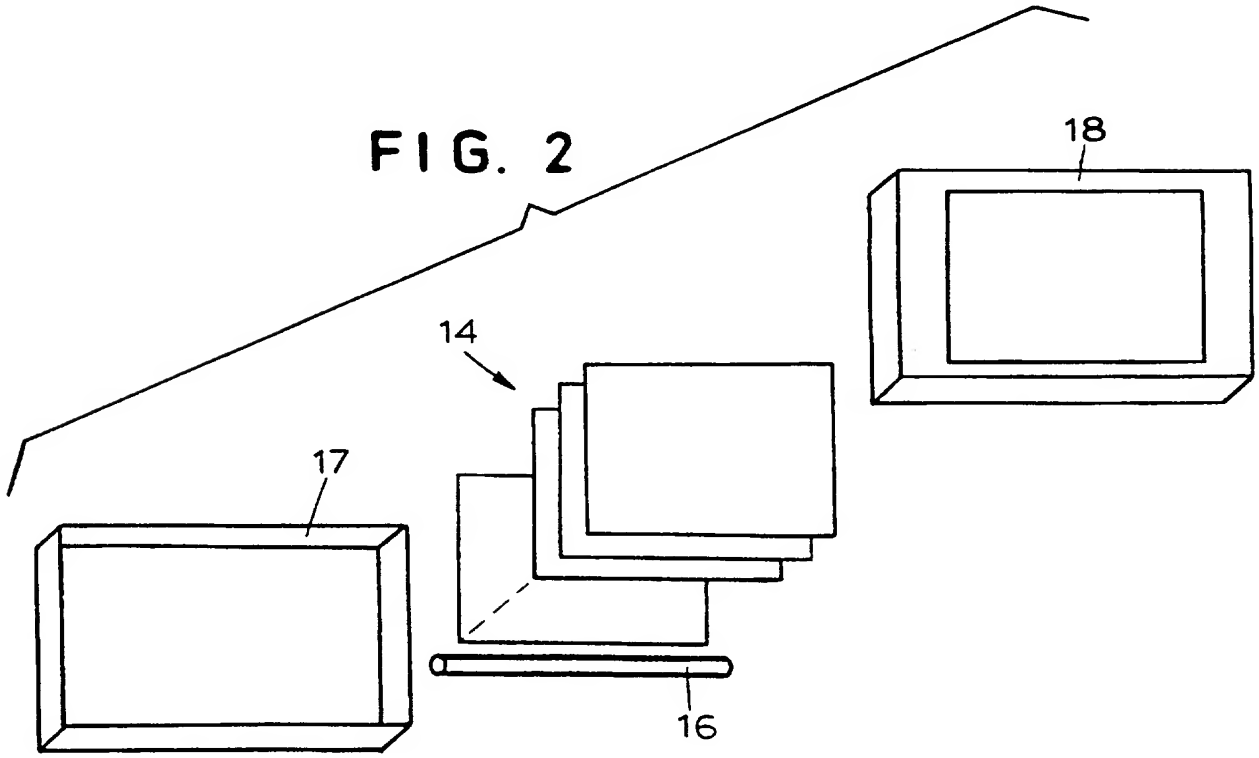

18
14
17
16

FIG. 3

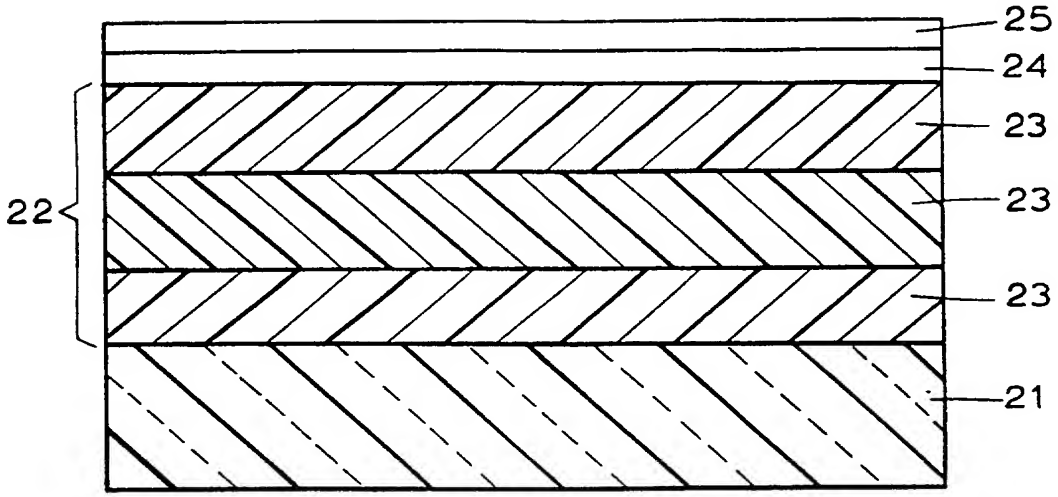
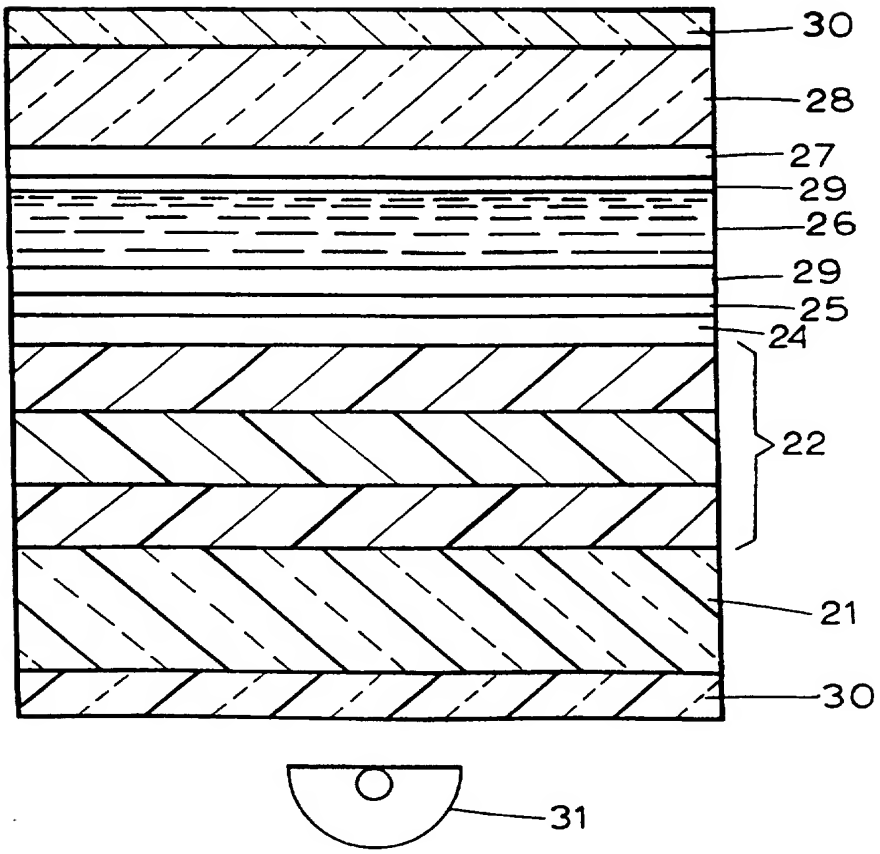


FIG. 4



INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/US 97/04501

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N1/60 G02F1/1335

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed byclassification symbols)
IPC 6 H04N G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 12143 A (BRODY THOMAS P) 4 May 1995 cited in the application see page 6, line 24 - page 11, line 20; figures 2-5 ---	1-3,14, 19,36-48
A	WO 94 08423 A (CACTUS ;BOWERS HARRY (US)) 14 April 1994 see page 7, line 15 - page 13, line 24; figures 1-4 --- -/--	1,4,5, 14, 30-32,36

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
24 July 1997	31/07/1997

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	THEOPISTOU, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter. ional Application No
PCT/US 97/04501

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 83 03941 A (SCHREIBER WILLIAM F) 10 November 1983 cited in the application see page 8, line 15 - page 14, line 20 see page 19, line 32 - page 24, line 6; figures 1,2,4,5	1,4-6,9, 10,14, 15,17, 18, 30-33,36
A	PATENT ABSTRACTS OF JAPAN vol. 010, no. 338 (P-516), 15 November 1986 & JP 61 140923 A (KONISHIROKU PHOTO IND CO LTD), 28 June 1986, see abstract	1-3,14, 36-39, 42,43, 46-48
A	US 5 481 655 A (JACOBS MICHAEL) 2 January 1996 see column 2, line 16 - column 3, line 35 see column 4, line 21 - column 5, line 31; figure 1	1,4,5,9, 14, 30-33,36
A	US 5 426 517 A (SCHWARTZ MICHAEL) 20 June 1995 see column 4, line 35 - column 5, line 17 see column 5, line 67 - column 6, line 53 see column 8, line 59 - column 9, line 37; figures 3,8,9	1,14,30, 36

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 97/04501

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9512143 A	04-05-95	US 5463484 A	31-10-95
		EP 0746794 A	11-12-96
WO 9408423 A	14-04-94	US 5296947 A	22-03-94
		AU 5295893 A	26-04-94
		EP 0664065 A	26-07-95
WO 8303941 A	10-11-83	US 4500919 A	19-02-85
		EP 0108126 A	16-05-84
US 5481655 A	02-01-96	NONE	
US 5426517 A	20-06-95	NONE	